

CURRENT SEROPREVALENCE OF HEPATITIS A VIRUS INFECTION AMONG KINDERGARTEN CHILDREN AND TEACHERS IN TAIWAN

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Abstract. Taiwan was a hyperendemic area for hepatitis A virus (HAV) infection before the late 1980s. The seroprevalence of HAV infection was higher than 90% with most HAV infection occurring during childhood. This study was to estimate the seroprevalence of HAV infection among preschool children in central Taiwan. A community-based survey was carried out in 54 kindergartens in 10 urban areas, 10 rural areas and 2 aboriginal areas randomly selected through stratified sampling. Serum samples of 2,549 healthy preschool children and 104 teachers in study kindergartens were screened for the HAV antibodies (anti-HAV) by means of a commercially available microparticle enzyme immunoassay (AxSYM HAVAB). Among aboriginal kindergarten children, more than 96% of them were anti-HAV seropositive due to a mass HAV vaccination program. In urban and rural areas, kindergarten children had a very low prevalence of anti-HAV (0.4%) in contrast to a high seroprevalence in their teachers (78%). There was no gender difference in seroprevalence of anti-HAV, while the anti-HAV seroprevalence was significantly higher in urban areas than in rural areas. Crowdedness of living in urban areas might facilitate the person-to-person transmission of infectious agents

INTRODUCTION

Hepatitis A virus (HAV) is a single-stranded RNA virus in the picornavirus family and is the cause of hepatitis A. HAV is transmitted predominantly through the fecal-oral route. Outbreaks are often related to contaminated water and improperly prepared or handled food (Foff, 1995). Taiwan was a hyperendemic area for HAV infection before the late 1980s (Wu *et al*, 1980). The seroprevalence of HAV infection was higher than 90% with most HAV infection occurring during childhood (Wu *et al*, 1982). A striking decline in the prevalence of HAV infection was observed among children in Taiwan (Liu *et al*, 1994; Wang *et al*, 1993; Wu *et al*, 1993). There are no data on the seroprevalence of HAV infection among preschool children in central Taiwan. The aim of this study was to estimate the seroprevalence of HAV infection among preschool children by geographic area, age and gender in central Taiwan.

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MATERIALS AND METHODS

Study population and subject selection

The central area of Taiwan, including Taichung County and Taichung City, Miaoli County, Changhua County and Nantou County, was chosen as the study area. A total of 54 kindergartens in 10 urban areas and 10 rural areas and 2 aboriginal areas in the study area were randomly selected as the study kindergartens. Preschool children and their teachers in the kindergartens were enrolled on a voluntary basis. There were 502 kindergarten children in aboriginal areas, 2,047 kindergarten children and 104 kindergarten teachers in urban and rural areas were recruited in this study. All aboriginal children were immunized by HAV vaccine. A blood sample was collected from each subject, and serum specimens were kept at -70°C until laboratory examination.

Laboratory examination

Serum hepatitis A antibodies (anti-HAV) were analyzed by means of a commercially available microparticle enzyme immunoassay (AxSYM HAVAB, Abbott Laboratories, Abbott Park, IL, USA) on an AxSYM analyzer. Serum samples with S/CO

(sample rate/cutoff rate) values in the range of 0 to 1 were considered reactive for hepatitis A antibodies.

Data analysis and statistical methods

Statistical analysis was performed separately for subjects lived in aboriginal and non-aboriginal areas using the SAS software system (SAS Institute, Inc, Cary, North Carolina, USA). Because all aboriginal children had already been immunized by HAV vaccine, the prevalence of anti-HAV seropositivity may reflect both natural infection and vaccination status. The increasing trend of age-specific seropositive rates in urban and rural areas were tested for statistical significance by the chi-square test for trend. Multivariate-adjusted odds ratios (OR) with their 95% confidence intervals (CI) were estimated through the multiple logistic regression analysis, in which statistically significant risk factors for anti-HAV seropositivity in univariate analysis were included in the regression models for kindergarten children and teachers, respectively.

RESULTS

There was a very high seroprevalence of anti-HAV (483/502 = 96.2%) among aboriginal kindergarten children who had all been immunized by HAV vaccine. As shown in Fig 1, the anti-HAV seroprevalence was found to increase significantly with age in urban and rural areas ($p < 0.0001$).

Table 1 shows that the seroprevalence of anti-HAV was similar for boys (0.4%) and girls (0.5%) among kindergarten children. No statistically significant gender difference in anti-HAV seroprevalence

was observed among teachers either. The seroprevalence of anti-HAV was higher in urban areas than in rural areas for both kindergarten children and teachers as shown in Table 1.

Table 2 shows the results of multiple logistic regression analysis. There was no gender difference

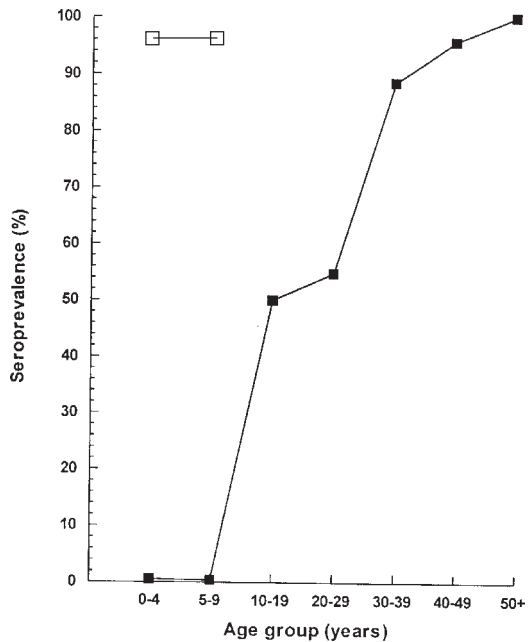


Fig 1—Age-specific seroprevalence of antibodies against hepatitis A virus among 502 kindergarten children in aboriginal areas (□) and 2,047 kindergarten children and 104 teachers in urban and rural areas (■).

Table 1
Seroprevalence of antibodies against hepatitis A virus by sex and study areas among kindergarten children and teachers in central Taiwan.

| Variable | Children (≤6 years) | | | Teachers (≥18 years) | | |
|-------------|---------------------|--------------|-----|----------------------|--------------|-------|
| | Tested No. | Seropositive | | Tested No. | Seropositive | |
| | | No. | (%) | | No. | (%) |
| Sex | | | | | | |
| Female | 953 | 5 | 0.5 | 95 | 73 | 76.8 |
| Male | 1,094 | 4 | 0.4 | 9 | 9 | 100.0 |
| Study area | | | | | | |
| Urban areas | 1,276 | 7 | 0.6 | 64 | 54 | 84.4 |
| Rural areas | 771 | 2 | 0.3 | 40 | 28 | 70.0 |

in the seroprevalence of HAV infection in this study. A significantly increased seroprevalence was observed among the teacher group after multivariate adjustment. Seroprevalence was significantly higher in urban areas than in rural areas.

DISCUSSION

The infection of HAV was very prevalent in Taiwan, especially in aboriginal areas, before early 1980s. The seroprevalence of HAV infection was more than 90% among adults in the general population (Wu *et al*, 1980, 1982). Outbreaks of hepatitis A still occurred sporadically in aboriginal area in late 1980s and 1990s. A mass HAV vaccination program was implemented in aboriginal area in mid-1990s. As all aboriginal kindergarten children study had immunized by HAV vaccine, more than 96% of them were seropositive for anti-HAV. It suggests that HAV vaccination is quite effective with regards to the presence of anti-HAV in the sera of vaccinees.

The finding is consistent with that reported previously (Lee *et al*, 1996; Fan *et al*, 1998).

Kindergarten children in urban and rural areas were not vaccinated. The seropositivity of anti-HAV may reflect their accumulated incidence of HAV infection. The HAV prevalence among preschool children in Taiwan by various years is shown in Table 3. The seroprevalence of anti-HAV among schoolchildren in non-aboriginal areas was as high as 28% in 1984 (Chen *et al*, 1990). It was found to decrease rapidly from 89% in 1975 to 10% in 1991 among adolescents in Taipei City (Wang *et al*, 1993). We found non-aboriginal preschool children had an anti-HAV seroprevalence of 0.4%. It was lower than those reported among healthy children (1.0-13.1%) in Taipei in 1980s (Wu *et al*, 1982; Hsu *et al*, 1985) and those among kindergartens children (0.6-2.6%) in Tainan (southern of Taiwan) in early 1990s (Liu *et al*, 1994; Wu *et al*, 1993).

In this study, there was almost no evidence of HAV infection (0.44%) among kindergarten children in urban and rural areas. As shown in Fig 1, there was an increasing trend of seroprevalence of anti-HAV with age. The anti-HAV seroprevalence was greater than 50% among kindergarten teachers who were more than 15 years old. They were born before the early 1980s, when Taiwan was a hyper-endemic area for HAV. The finding suggests these teachers might be infected in their early childhood. It seem to imply the improvement in water supply system, sewage disposal and food sanitation along with the economic growth has already reduced the risk of being infected by HAV strikingly in central Taiwan.

The reason for a significantly higher seroprevalence in urban areas than in rural areas deserves further investigation. Crowdedness of living in urban areas might facilitate the person-to-person transmission of infectious agents. Whether HAV may also be transmitted through such a transmis-

Table 2
Multivariate-adjusted odds ratios and 95 % confidence intervals based on a multiple logistic regression model.

| Variable | Hepatitis A virus | | |
|-------------|-------------------|----------|---------|
| | OR | 95% CI | p-value |
| Sex | | | |
| Female | 1.0 | referent | |
| Male | 1.1 | 0.4-3.5 | 0.82 |
| Age group | | | |
| Children | 1.0 | referent | |
| Teachers | 651 | 424-999 | <0.0001 |
| Study area | | | |
| Urban areas | 1.0 | referent | |
| Rural areas | 0.4 | 0.2-0.9 | 0.03 |

OR= odds ratio; CI= confidence interval

Table 3
Comparison of prevalence of HAV among non-aboriginal children in Taiwan.

| Authors (year) | Blood collection | | Age (year) | Tested No. | HAV prevalence |
|-------------------------|------------------|--------|------------|------------|----------------|
| | Area | Year | | | |
| Wu <i>et al</i> (1982) | Taipei | 1979 | 1-6 | 259 | 13.1% |
| Hsu <i>et al</i> (1985) | Taipei | 1984 | 3-6 | 415 | 1.0% |
| Wu <i>et al</i> (1993) | Taiwan | 1989 | 3-6 | 176 | 0.6% |
| Liu <i>et al</i> (1994) | Taiwan | 1992 | 3-6 | 156 | 2.6% |
| This study (1999) | Central Taiwan | 1995-6 | 3-6 | 2,047 | 0.4% |

sion route remains to be classified.

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